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Hydro-meteorological predictions from GCM simulations: downscaling techniques and uncertainty modelling

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Abstract Hydrological implications of global climate change are usually assessed by downscaling appropriate predictors simulated by General Circulation Models (GCMs). Results from GCM simulations are subject to a number of uncertainties due to incomplete knowledge about the underlying geophysical processes of global change (GCM uncertainties) and uncertain future scenarios (scenario uncertainties). Disagreement between projections of regional climate change suggests that reliance on a single GCM with a few selected scenarios could lead to inappropriate planning and adaptation responses. This paper summarizes recent published work by the authors. The following methods and tools for statistical downscaling are discussed: (a) Fuzzy Clustering, (b) Relevance Vector Machine (RVM) and (c) Conditional Random Fields (CRFs). Uncertainty modelling with non-parametric methods and possibility theory are discussed. Applications of the methodologies are demonstrated by projection of the meteorological drought in the Orissa subdivision, India, and by predictions of the inflow to Hirakud Dam, Mahanadi River basin in India.

Key words downscaling; uncertainty; fuzzy clustering; relevance vector machine; possibility; conditional random fields